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AUTHOR	Balajthy, Ernest
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ABSTRACT

When matched for achievement level and educational objectives, computer technology can be particularly effective with at-risk students. Computer-assisted instructional software is the most widely available type of software. An exciting development pertinent to literacy education is the development of the "electronic book" (also called "interactive text"). Another important development is the introduction of interactive multimedia materials. The increased use of voice synthesis has revolutionized computer-based word recognition software. One of the most useful peripheral devices for young children and their emerging literacy is an alphabetic keyboard in which letters are displayed in alphabetic order. Drill and practice software is easy to create and popular with schools, while software designed for authentic literacy activities is sometimes more difficult to use but more flexible and useful. Another important type of emergent literacy software is language experience approach story creation software. An increasing number of publishers have begun to target the market for bilingual and English-as-a-Second-Language software. Availability of high quality, motivational software for comprehension is still somewhat limited. Many high-interest software simulations involve students in large amounts of time-on-task in active reading. In addition to now-familiar standard word processing operation, computer writing software can provide guidance for writers in terms of topic and structure, offering a framework to support writing. Word processors specifically designed for children's use have increased in sophistication over the years. (Contains 5 references and 32 computer software references.) (RS)

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Using Computer Technology to Aid The Disabled Reader

Dr. Ernest Balajthy

School of Education

State University of New York at Geneseo

Geneseo, NY 14454

716-245-5558

Email: Balajthy@UNO.CC.GENESEO.EDU

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Computers can be particularly effective with at-risk students. Both research and teacher experience show that many such students are motivated by technology. Technology allows teachers to deal in new and innovative ways when teaching students concepts and skills for which those students have many times developed negative attitudes due to continued failure. The very newness of the technology can help teachers work around those negative attitudes. In addition, computers provide status to the users, suggesting that they are engaged in "cutting edge" learning. That status can work to overcome the negative image often associated with instruction of at-risk students.

Computers, however, require a major commitment of time and energy on the part of the teacher, both in terms of initial learning of computer literacy and in terms of ongoing planning and monitoring of students' computer use. Teachers must choose carefully how to use computers in their classrooms to take advantage of their benefits and to make an appropriate fit between the regular classroom curriculum and technology.

This paper focuses on use of the computer in literacy instruction of at-risk students. As with most traditional instructional methods, it is usually inappropriate to designate certain computer software as more appropriate for low-achieving students. Most software has been designed

for use with average achievers, but when matched for achievement level and educational objective, these programs can be very effective with low-achieving students.

Computer technology is used to supplement, not to supplant, the human teacher. As with any educational tool, computers are only effective when used appropriately. Only the individual human teacher in connection with his or her students can determine what is appropriate in any given situation.

This paper begins with an overview of contemporary trends in computer-based instruction that affect the instruction of disabled readers. Three sections follow, describing software appropriate for use in developing emergent and early literacy, comprehension and text reading, and writing.

Contemporary Trends in Computer-Based Instruction

Robert Taylor (1980) listed educational computer use (often called computer-based instruction, or CBI) in three categories: Computer as a tutee, tutor, and a tool. Interest in computer as tutee, or programming, has declined in recent years as educators have questioned both the wisdom of devoting large blocks of classroom time to teaching programming and

the importance of programming ability to most vocations. Teachers have also been skeptical about the transfer of problem-solving skills from programming to other domains such as reading and writing.

Computer-assisted instructional software, use of the computer as a tutor, is the most widely available type of software. However, it is the third type of software, tool (or "application") software, that today receives the most attention from researchers and theorists in literacy education. In part, deemphasis on tutor software in literacy education has come about because of increased recognition of the importance of process education, that students learn by doing. Tool software can help teachers committed to wholistic education to engage students in writing and reading their own stories and in other authentic literacy activities.

An exciting new development pertinent to literacy education is the development of the "electronic book" (also called "interactive text"). Electronic books take many forms, depending on their purpose. One type, designed for literacy experiences of beginning and at-risk readers, simulates reading aloud to children. Screen pages and illustrations are presented on the monitor. Children may access voice synthesized pronunciations and definitions (and even translations into Spanish) by pointing the cursor at unrecognized words and pressing a key.

Increased memory and processing capabilities for hardware has made possible the widespread use of digitized voice synthesis, which

allows production by computers of clearly understood human-sounding voice. Older technologies usually depended solely upon print or graphics, with occasional use of robotic-sounding phonemic voice synthesis. Voice recognition by computers is still at a primitive developmental stage, but it will be increasingly available. The Optimum Resource Reading Program provides a series of drills based on letter cluster linguistic phonics elements in words. Students wear headphones with attached microphones into which they can speak answers. A letter cluster appears on the screen, such as "li", and the student is asked to say its sound. The computer then analyzes the voice input to determine whether the answer was correct.

Another fascinating development is the introduction of interactive multimedia materials, which combine the capabilities of computers with such multimedia devices as CD-ROM and videodiscs. In the Martin Luther King, Jr. interactive multimedia package, for example, students use a workstation equipped with a videodisc player and monitor connected by cable to a computer. The computer provides a large amount of print information, such as the verbatim speeches of King, summaries of news events from his life, a time line of important events, a glossary, and digitized photographs. Students also use the computer to control the videodisc player, clicking on icons to access videos of television news clips and of King's speeches.

Computers are available in almost 50% of American homes. Many of these computers sit idle, but increasingly parents whose jobs call for frequent use of computer technology are buying and using computers for home tasks. Their interest in using these computers as educational tools for their children has led to unexpected developments. First, since most businesses use hardware developed by or compatible with IBM formats (such as MS-DOS or Windows), parents tend to buy hardware of that variety. This has led software developers to tremendously increase their attention to educational software that fits those formats, a change from the 1980's when almost all software for children was designed for Apple Computer Corporation machines, the Apple II-series and Macintosh. Second, parents are less concerned with on-task learning behaviors in their software purchases than would be most teachers. This has led to development of "edutainment" software, software that combines high entertainment value with educational objectives. In many cases, the "edu" part of the software plays a decidedly minor role in comparison to the "tainment." Third, parents want more for their money than schools demand. A school might be willing to spend $50 for a piece of software that will be used with 30 students each year over a several year period to practice one activity. In order to attract home buyers who only have one or two children to spend that same $50, software publishers realize that they have to provide a variety of high interest activities. This has led to

multiple-activity software such as the 5-disk The Backyard, which offers 6 major games relating to science, mapping skills, and animal habitats, as well as a host of minor activities.

Software for Emergent and Early Literacy

The increased use of voice synthesis, the computer's ability to produce speech, has revolutionized computer-based word recognition software. Now, not only can letters and words be displayed on the monitor, but they can be pronounced aloud by the computer. Quality of voice synthesis has also improved tremendously. Older software depended upon a primitive robotic-sounding "phonemic voice synthesis," in which words were created by blending phoneme sounds. Newer software takes advantage of the much-increased memory capabilities and information handling speed of newer model computers to use a more sophisticated phonemic voice synthesis. Newer software also often uses "digitized voice synthesis", which is based on the same digitization process used in professional music recording studios. Quality varies in digitized voice synthesis, but at its best it sounds as good as a tape recording.

Not only can young children obtain high quality speech from their software, but their software now brings them television and movie stars to teach word recognition skills. From Barney the Dinosaur to Big Bird or

the Muppets to Mickey Mouse, children have a wide choice of characters who function in almost identical software to provide drill and practice. A child as young as three years can learn to use this software independently if introduced with close adult guidance. At that age, of course, attention spans are limited.

One of the most useful peripheral devices for young children is an alphabetic keyboard in which the letters are displayed in alphabetic order. Children can largely avoid the hunt and peck routine required by the standard QWERTY keyboard, so named for the letters in the upper left hand row. The Muppet Keyboard (Sunburst/Wings for Learning, 101 Casteton Street, P.O. Box 100, Pleasantville, NY 10570, 800-545-7677) is a popular alphabetic keyboard and is illustrated with pictures of favorite Muppet characters. Soon after kindergarten, however, children should begin to learn touch typing on the QWERTY keyboards they will use in later years. A wide variety of colorful keyboarding tutorials are available for children, but all these are notoriously ineffective in teaching touch typing unless accompanied by close adult supervision. Touch typing is best learned when taught by a trained keyboarding instructor.

Drill and practice software is easy to create and very popular with schools. A wide variety of such software exists for development of word recognition. Almost every major software publisher makes such drills available. Many of these are indistinguishable from one another except for

the cartoon characters involved. One very popular program with children is the drill game Word Munchers. Children guide a Pacman-like image around a grid on the monitor screen to identify and "eat" words with vowel sounds identical to that in a target word at the top of the screen.

The Whole Language Movement of the late 1980's reemphasized the need for authentic literacy activities to replace the preponderance of subskill drill and practice materials that had become dominant in literacy education. Software designed for authentic literacy activities is sometimes more difficult to use than the simpler drill and practice word recognition software, but it is also often more flexible and more useful.

One important type of software for emergent literacy is the electronic book. These books facilitate independent reading on the part of young readers by providing help similar to that which might be given by a teacher or parent reading to the child--namely, pronunciation of unfamiliar words using voice synthesis. Children typically are presented screen pages of words and pictures from stories. They can read the story, see animation of the pictures, and sometimes will be asked questions about the story. When they encounter an unfamiliar word, they can use arrow keys on the keyboard or the mouse to point the cursor at the word, press a key and the word will be pronounced aloud. Even the electronic books designed for older model computers are helpful, but the newer CD-ROM-based electronic books such as the Discus series (which includes

Beatrix Potter's Peter Rabbit and, for older readers, a series that includes works by Edgar Allen Poe) and the Broderbund series (which includes Mercer Mayer's Just Grandma and Me and Marc Brown's Arthur's Teacher Trouble) have startlingly effective graphics and high quality speech. Broderbund's series is particularly motivating, as it includes a great deal of high-interest interaction. In a screen picture of Arthur working on a social studies project in his bedroom, for instance, clicking on his toy dragon will cause it to roar and spout fire, and clicking on his little sister will cause her to fall off the bed. It is questionable whether such interactivity adds to or distracts from the literacy development aspects of the software, but there is no doubt but that children enjoy the fun.

Another important type of emergent literacy software is language experience approach story creation software. This software functions in a variety of ways. Some programs, such as KidPix and Kid Works 2 are essentially talking word processors with painting options. Children type in stories themselves or with a teacher's help and save the stories on disk. Children can use a microphone connected to the computer to record their own voice or sound effects in reading their stories. The recording, picture and story are saved on disk and can be replayed whenever the child desires. In Kid Works 2, a voice synthesis component involving phonics rules (called "phonemic voice synthesis") can allow the stories to be automatically pronounced aloud. Some software allows the stories to be

illustrated using computer graphics. Kid Works 2 can also be used to create rebus stories.

The Storybook Weaver series works like a word processor with pictures. Students select scenes from the software topics (such as "World of Make-Believe" and "World of Adventure") which appear on the monitor screen. They make additions or changes to the scene by drawing or by "pasting" predrawn figures on the screen. Below the scene is a space for children to write their own stories.

Other software allows children to create their own pictures on the computer screen using a stored disk library of "paste-on pictures" of such characters as Garfield (Create with Garfield) or teddy bears (Teddy Bearrels of Fun). They simply choose the picture they want from a menu, move it to the desired location on the screen, and "stamp" it there. The children then type in words and sentences to describe the action or scene. Story results can be stored on disks and reread using the computer, or they can be printed out in color to make student-created books.

An increasing number of publishers have begun to target the market for bilingual and English as a Second Language software. The large memory capabilities of CD-ROM materials allows for inclusion of other languages. Both the Discus series and Broderbund series of CD-ROM electronic books, for instance, include options for translation of materials into Spanish. Some Broderbund titles even include a Japanese

option. The ABC News Interactive Video series of videodiscs uses the second audio track standard on videodiscs to provide a Spanish translation. SuperPrint, an application program designed for the creation of color illustrated booklets, big books, and large posters, now has a command that allows students to toggle back and forth between English and Spanish commands. The Bilingual Writing Center is a version of the newspaper-creation program Children's Writing and Publishing Center, with documentation in Spanish and with a font that allows input of text characters used in Spanish.

Software for Comprehension and Text Reading

Availability of high quality, motivational software for comprehension is more limited than for word recognition. Drill and practice software for comprehension development is widely available, but its usefulness and ability to maintain student interest are questionable. Some publishers are attempting to address comprehension development concerns with more holistic, innovative software designs.

The Comprehension Connection is based on Reinking and Schreiner's 1985 research into development of metacognitive "learning to learn" skills using computers. This series, designed for grades 4-9, involves students in reading content area science and social studies passages,

answering questions, and receiving feedback on their comprehension performance. At any point during reading, students can reread the passage or access a variety of comprehension aids such as an on-line dictionary, an easier version of the passage, a summary of the main ideas, or an animated graphic. Reinking and Schreiner found that the computer-based feedback allows students to examine their own learning processes and develop metacognitive "fix-up" strategies to improve learning.

Electronic versions of books for intermediate readers, such as Alexander and the Terrible, Horrible, No Good Very Bad Day by Judith Viorst, designed for comprehension development have been published by Houghton Mifflin in their Reading Comprehension series. Students can page through the story displayed on their monitors with accompanying animated graphics. Voice synthesized pronunciation of unfamiliar words can be accessed by pointing a cursor at the word and pressing the carriage return key. After each page, questions are provided. Each story in the Reading Comprehension collection has questions targeted to two specific comprehension skills, such as prediction, inferencing, and pronoun reference. Student performance on the various skills is recorded on-disk for future teacher reference.

Several series of "choose-your-own-ending" stories have been adapted to the computer and illustrated colorfully. This style of electronic book is designed to encourage interaction with the reader, and

unenthusiastic readers find this involvement to be motivating. Jack and the Beanstalk and Hilary and the Beast provide both male and female protagonists in various adventures.

Many high-interest software simulations involve students in large amounts of time-on-task in active reading. The Carmen Sandiego series, for example, includes such titles as Where in Time is Carmen Sandiego (a simulation of time travel through historical events), Where in the USA is Carmen Sandiego and Where in the World is Carmen Sandiego (simulations of world travel). In these games, students act out the part of detectives. In order to find clues as to the location of the archcriminal Sandiego, they must actively read a variety of reference books which accompany the software. MECC's newer versions of Oregon Trail and Odell Lake are history and ecology simulations which involve study of printed information. Tom Snyder Productions offers a series of reading-rich decision-making simulations on social studies issues, designed for cooperative learning by students achieving as low as the fourth grade level. Topics include Substance Abuse, Decisions: AIDS, Prejudice, and On the Campaign Trail.

Vocabulary instruction lends itself to computer gaming. The popular Word Attack! provides preprogrammed word lists or teachers can type in their own words, definitions, and sample sentences. As a culminating drill and practice activity after studying the definitions and sentences,

students play fast-paced video games. In one, they must shoot down the vocabulary word that corresponds to the definition printed at the bottom of the monitor screen.

Software for Writing

There is no doubt but that the most important contribution of computers to the classroom has been in the area of writing. Ease of revision for practical implementation of the principles of writing process has become a reality with word processing. The interest value of computer-based writing also makes a significant contribution to the teaching and learning of writing, especially with students who may need special motivation to overcome their frustration with slow achievement.

In addition to now-familiar standard word processing operation, computer writing software can provide guidance for writers in terms of topic and structure, offering a framework to support writing. The software can also provide feedback, especially in terms of mechanics of writing. Colorful software available today, used in creative and stimulating ways, can work to maintain student interest. Newer multimedia software allows children to go beyond simple text to add illustrations and pictures, sound and voice, and even video segments to their writings.

Most word processors available today are equipped with spelling checkers. A variety of programs are available that analyze text files created by word processors and provide feedback on stylistic, usage, and mechanical errors. Ghostwriter, for example, is specifically designed for students' use.

Many teachers use word processors designed for adults. These work well with young children when introduced carefully, avoiding confusing children with too many sophisticated and rarely used options. A wide variety of manuals designed to help teachers use adult word processors such as ClarisWorks and MicroSoft Works are available on the market.

Word processors specifically designed for children's use have tremendously increased in sophistication over the years. One of the original word processing programs designed for classroom use, Bank Street Writer, has been updated continually since its first publication. It now allows printing in color, incorporation of graphics with the text, creation of newsletters with titles and double columns, incorporation of hypertext-like "buttons" that allow writers to connect readers to other files or pictures, and many other advanced features.

One of the most popular word processing programs for classroom use has been The Writing Center (called Children's Writing and Publishing Center in its older Apple II version). While this program can be used to create standard compositions, its major purpose is classroom desktop

publishing, the simple creation of two-column classroom newspapers. Articles can be headlined with a variety of large font sizes and illustrated from a wide selection of prepared drawings. The newspaper can be printed with pictures in color. Classroom newspapers published using computers lend themselves to the short articles typical of elementary level students.

The Multimedia Workshop takes advantage of newer, more powerful computers to build upon the desktop publishing capabilities of older software such as The Writing Center to add functions, including multimedia capability. Text can be read aloud using voice synthesis. The program includes a spelling checker. A paint component allows students to create their own graphics or modify graphics included with the program. The multimedia component provides CD-ROM disks with hundreds of photographs, illustrations, music, sound effects and even short video segments that can be incorporated into computer-based student creations.

For teachers who wish to use computers for direct instruction in writing mechanics, a wide variety of software is available, though concern must be raised about the limited potential of transfer of such activities to real writing. In Grammar Toy Shop, for example, children see toy dinosaurs, animals and other creatures as parts of speech, verb tense, sentence structure, and subject/verb agreement are taught and drilled. Grammar Gazette offers students newspapers such as Mad News, Weird News, and Pig Tales and related grammar activities. Group Grammar also

provides students with error-filled passages to read (in this case, stories), and the computer activities are designed for small groups in cooperative learning or team competition exercises.

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ABC News Interactive Videodiscs, Optical Data Corporation, 30 Technology Drive, Box 4919, Warren, NJ 07060, 201-668-0022

Arthur's Teacher Trouble, Broderbund Software, P.O. Box 6125, Novato, CA

94948, 415-382-4700

The Backyard, Broderbund Software, P.O. Box 6125, Novato, CA 94948, 415-382-4700

Bank Street Writer, Scholastic Software, PO Box 7501, Jefferson City, MO 65102, 800-541-5513

Children's Writing and Publishing Center, The Learning Company, 6493 Kaiser Dr., Fremont, CA 94555, 800-852-2255

Decisions: Aids, Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA 02172-2817, 800-342-0236

Ghost Writer, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

Grammar Gazette, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

Grammar Toy Shop, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

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Jack and the Beanstalk, Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA 02172-2817, 800-342-0236

Hilary and the Beast, Tom Snyder Productions, 80 Coolidge Hill Road,

Watertown, MA 02172-2817, 800-342-0236

Hypercard, Claris Corporation, 5201 Patrick Henry Dr., Santa Clara, CA 95052

Just Grandma and Me, Broderbund Software, P.O. Box 6125, Novato, CA 94948, 415-382-4700

KidPix, Broderbund, PO Box 6125, Novato, CA 94948-6125, 800-521-6263

Kid Works 2, Davidson & Associates, P.O. Box 2961, Torrance, CA 90509, 800-556-6141

The Literary Mapper, Teacher Support Software, 1035 N.W. 57th St., Gainesville, FL 32605-4486, 800-228-2871

On the Campaign Trail, Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA 02172-2817, 800-342-0236

Peter Rabbit, Discus Books

Oregon Trail, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

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Storybook Weaver, MECC, 6160 Summit Drive North, Minneapolis, MN

55430-4003, 800-685-6322

Substance Abuse, Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA 02172-2817, 800-342-0236

SuperPrint, Scholastic Software, PO Box 7501, Jefferson City, MO 65102, 800-541-5513

Voyage of the Mimi and Voyage of the Mimi II, Sunburst/Wings for Learning, 101 Casteton Street, P.O. Box 100, Pleasantville, NY 10570, 800-545-7677

Wagon Train, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

Word Munchers, MECC, 6160 Summit Drive North, Minneapolis, MN 55430-4003, 800-685-6322

Worksheet Magic, Teacher Support Software, 1035 N.W. 57th St., Gainesville, FL 32605-4486, 800-228-2871

The Writing Center, Learning Company, 6493 Kaiser Dr., Fremont, CA 94555, 800-852-2255